US Micro Products
Electronic Products for the OEM

TFT-LCD PRODUCT SPECIFICATION

PART NUMBER:	USMP-PK070HD-01A
DESCRIPTION:	7" Active Matrix TFT-LCD, 1920 x 1080 RGB, 262K Full Colors

ISSUE DATE	APPROVED BY (Customer Use Only)	CHECKED BY	PREPARED BY
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2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY

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3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 7" FHD of 16:9 format amorphous silicon TFT. The pixel format is vertical stripe and sub pixels are arranged as R (red), G (green), B (blue) sequentially. This display is RoHS compliant, COG (chip on glass) technology and LED backlight are applied on this display.

Part Name	USMP-PK070HD-01A
Module Dimensions	169.0(W) mm x 104.0(H) mm x 10.0 (D) mm typ.
LCD Active Area	155.52(W) mm x 87.48(H) mm
Pixel Pitch	0.081(W) mm x 0.081 (H) mm
Resolution	1920 x 3(RGB)(W) x 1080(H) dots
Color Pixel Arrangement	R, G, B Vertical Stripe
LCD Type	Transmissive Color TFT; Normally Black
Display Type	Active Matrix
Number of Colors	16.7M Colors
Backlight	3 LEDs Series x 10 Parallel (30 LEDs in Total)
Weight	180 typ. (g)
Interface	LVDS; 20 pins
Power Supply Voltage	3.3V for LCD; 12V for Backlight
Power Consumption	0.53W for LCD; 5.16W for Backlight
Viewing Direction	Super Wide Version (In-Plane Switching)

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4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Remarks
Supply Voltage	V_{DD}	-0.3	4.0	V	-
Input Voltage of Logic	V_I	-0.3	V_{DD}+0.3	V	Note 1
Operating Temperature	Top	-20	70	$^{\circ}$C	Note 2
Storage Temperature	Tst	-30	80	$^{\circ}$C	Note 2
Backlight Input Voltage	V_{LED}	-	15	V	-

Note 1: The rating is defined for the signal voltages of the interface such as CLK and pixel data pairs.

Note 2: The maximum rating is defined as above based on the chamber temperature, which might be different from ambient temperature after assembling the panel into the application. Moreover, some temperature-related phenomenon as below needed to be noticed:

- Background color, contrast and response time would be different in temperatures other than 25°C.

- Operating under high temperature will shorten LED lifetime.

5. ELECTRICAL CHARACTERISTICS

5.1 LCD CHARACTERISTICS

$T_a = 25\ °C,\ V_{SS} = 0V$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	-	3.0	3.3	3.6	V	-
Differential Input Voltage for LVDS Receiver Threshold	V_I	"H" level	-	-	+100	mV	Note 1
		"L" level	-100	-	-		
Power Supply Current	I_{DD}	V_{DD}=3.3V	-	160	-	mA	Note 2
Vsync Frequency	f_v	-	-	60	-	Hz	
Hsync Frequency	f_H	-	-	67.5	-	KHz	Note 3
CLK Frequency	f_{CLK}	-	-	148.5	-	MHz	

Note 1: VCM=+1.2V

VCM is common mode voltage of LVDS transmitter/receiver.

LVDS Receiver Input Signal Operation Range
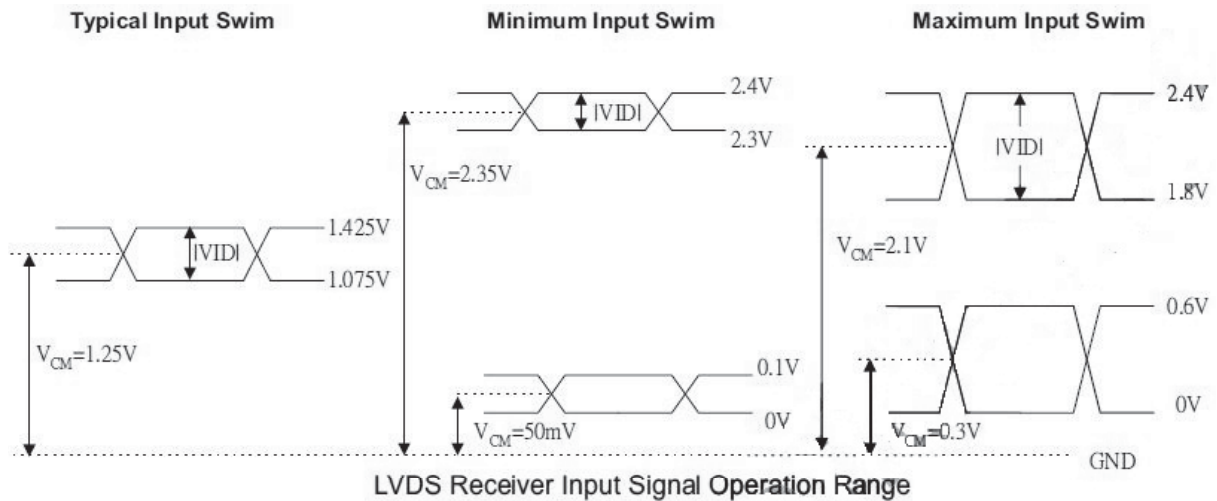
Note 2: An all white check pattern is used when measuring I_{DD}. f_v is set to 60 Hz.

Note 3: For LVDS transmitter input.

Note 4: 1.0A fuse is applied in the module for I_{DD}. For display activation and protection purpose, power supply is recommended larger than 2.5A to start the display and break fuse once any short circuit occurred.

5.2 BACKLIGHT CHARACTERISTICS

$T_a = 25\ ^\circ C$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
LED Input Voltage	V_{LED}	-	11.7	12	12.3	V	Note1
LED Forward Current (Dim Control)	I_{LED}	0V; 0% duty	-	430	-	mA	Note 2
		3.3VDC; 100% duty	-	40	-		
LED lifetime	-	I_{LED}=430 mA	-	70K	-	hrs	Note 3

Note 1: As Fig. 5.1 shown, LED current is constant, 430 mA, controlled by the LED driver when applying 12V.

Note 2: Dimming function can be obtained by applying DC voltage or PWM signal from the display interface CN1. The recommended PWM signal is 1K ~ 10K Hz with 3.3V amplitude.

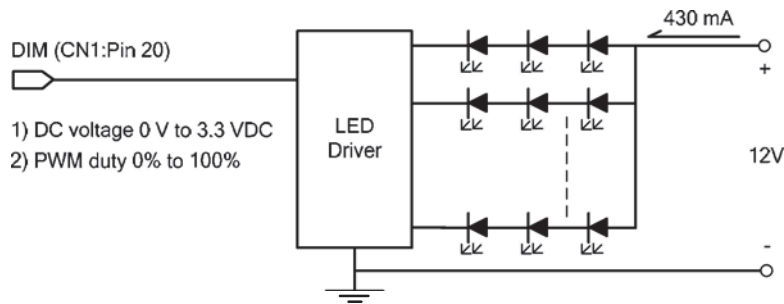Note 3: The estimated lifetime is specified as the time to reduce 50% brightness by applying 430 mA at 25°C.

Fig 5.1

6. OPTICAL CHARACTERISTICS

The optical characteristics are measured based on the conditions as below:

- Supplying the signals and voltages defined in the section of electrical characteristics.

- The backlight unit needs to be turned on for 30 minutes.

- The ambient temperature is $25\,^\circ\mathrm{C}$.

- In the dark room around 500~1000 lx, the equipment has been set for the measurements as shown in Fig 6.1.

$T_a = 25\ ^\circ C, f_v = 60\ \mathrm{Hz}, V_{DD} = 3.3\mathrm{V}$

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Brightness of White		-	$\phi = 0^\circ, \theta = 0^\circ,$ $I_{LED}= 430$ mA	-	700	-	cd/m^2	Note 1
Brightness Uniformity		-		70	-	-	%	Note 2
Contrast Ratio		CR		-	800	-	-	Note 3
Response Time (Rising + Falling)		$T_r + T_f$	$\phi = 0^\circ, \theta = 0^\circ$	-	23	-	ms	Note 4
Viewing Angle		θ x	$\phi = 0^\circ, CR \geq 10$	-	85	-	Degree	Note 5
		θ x$'$	$\phi = 180^\circ, CR \geq 10$	-	85	-		
		θ y	$\phi = 90^\circ, CR \geq 10$	-	85	-		
		θ y$'$	$\phi = 270^\circ, CR \geq 10$	-	85	-		
Color Chromaticity	Red	X	$\phi = 0^\circ, \theta = 0^\circ$	-	0.64	-	-	Note 6
		Y		-	0.33	-		
	Green	X		-	0.31	-		
		Y		-	0.61	-		
	Blue	X		-	0.15	-		
		Y		-	0.06	-		
	White	X		-	0.31	-		
		Y		-	0.31	-		

Note 1: The brightness is measured from the panel center point, P5 in Fig. 6.2, for the typical value.

Note 2: The brightness uniformity is calculated by the equation as below:

$$\text{Brightness uniformity} = \frac{\text{Min. Brightness}}{\text{Max. Brightness}} \times 100\%$$

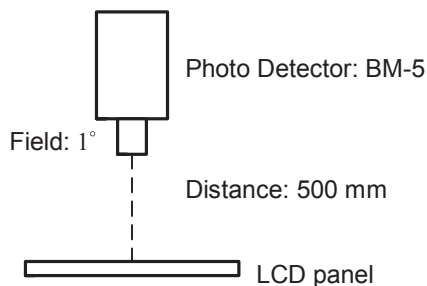, which is based on the brightness values of the 9 points measured by BM-5 as shown in Fig. 6.2.

Photo Detector: BM-5

Field: 1°

Distance: 500 mm

LCD panel

Fig. 6.1

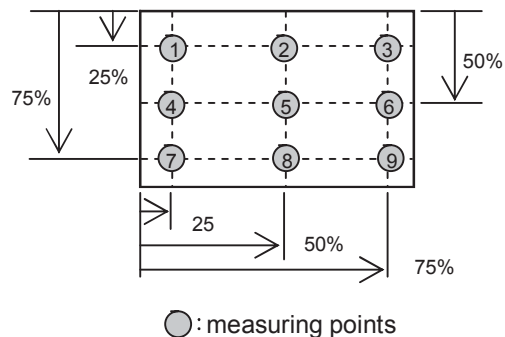25%   75%   50%   25   50%   75%

◯ : measuring points

Fig. 6.2

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Note 3: The Contrast Ratio is measured from the center point of the panel, P5, and defined as the following equation:

$$CR = \frac{\text{Brightness of White}}{\text{Brightness of Black}}$$

Note 4: The definition of response time is shown in Fig. 6.3. The rising time is the period from 10% brightness to 90% brightness when the data is from black to white. Oppositely, Falling time is the period from 90% brightness falling to 10% brightness.
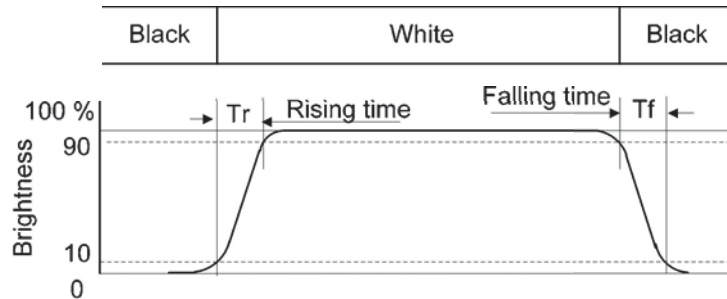
Note 5: The definition of viewing angle is shown in Fig. 6.4. Angle ϕ is used to represent viewing directions, for instance, $\phi = 270°$ means 6 o'clock, and $\phi = 0°$ means 3 o'clock. Moreover, angle θ is used to represent viewing angles from axis Z toward plane XY.

The display is super wide viewing angle version, so that the best optical performance can be obtained from every viewing direction.
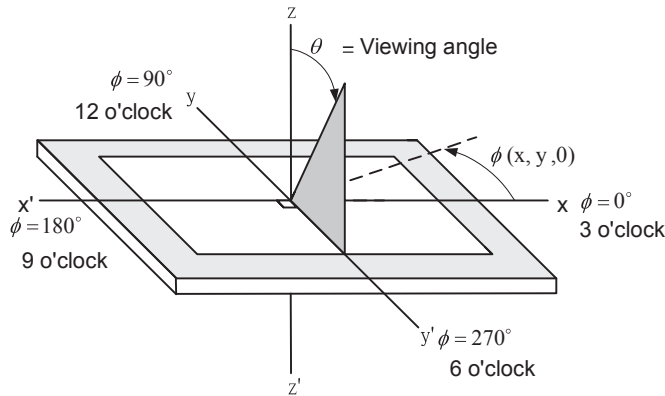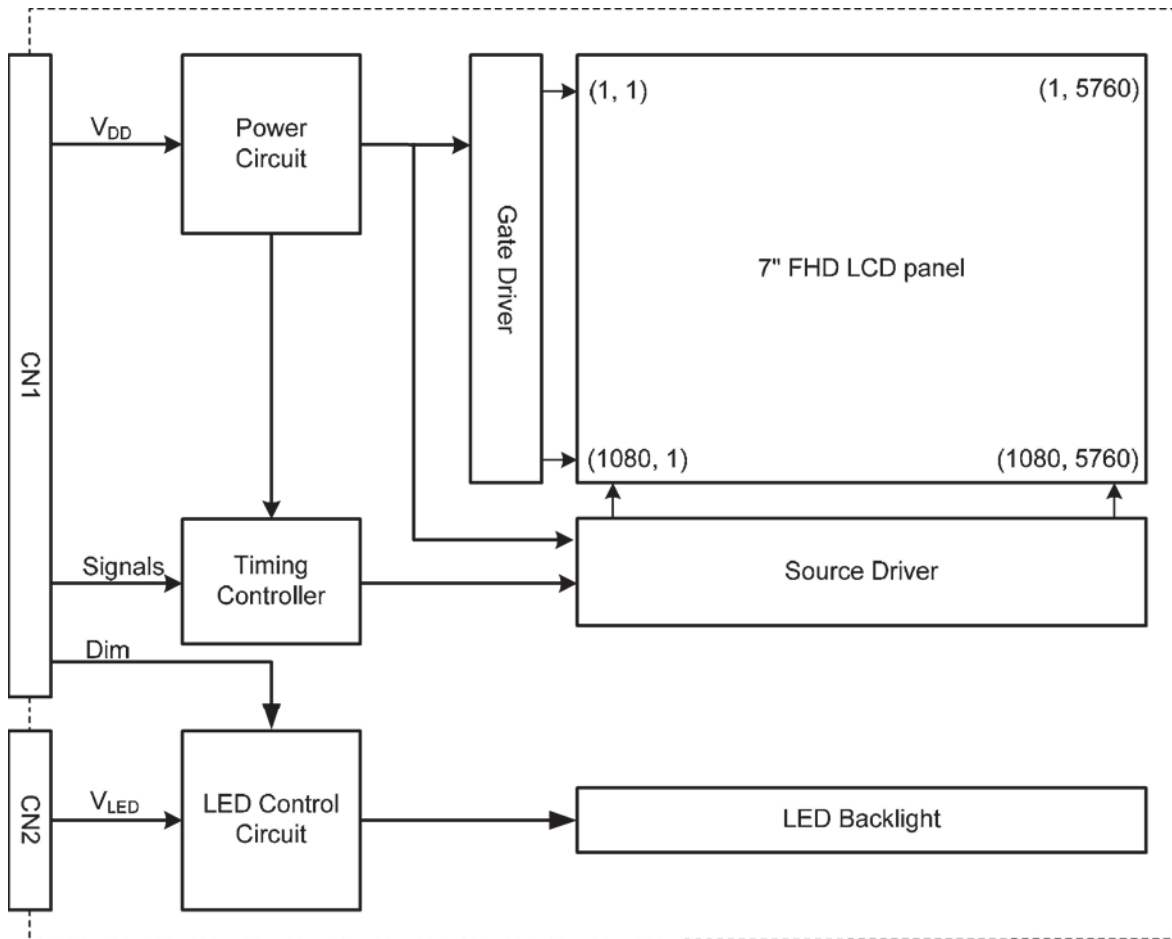

Fig 6.4

Note 6: The color chromaticity is measured from the center point of the panel, P5, as shown in Fig. 6.2.

7. BLOCK DIAGRAM

Note 1: Signals are CLK and pixel data pairs.

8. LCD INTERFACE

8.1 INTERFACE PIN CONNECTIONS

The display interface connector (CN1) and pin assignment is as below:

Pin No.	Symbol	Signal	Pin No.	Symbol	Signal
1	V_{DD}	Power Supply for Logic	11	IN2-	B2~B5, DE
2	V_{DD}		12	IN2+	
3	V_{SS}	GND	13	V_{SS}	GND
4	V_{SS}		14	CLK IN-	Pixel Clock
5	IN0-	R0~R5, G0	15	CLK IN+	
6	IN0+		16	V_{SS}	GND
7	V_{SS}	GND	17	IN3-	R6~R7, G6~G7, B6~B7
8	IN1-	G1~G5, B0~B1	18	IN3+	
9	IN1+		19	NC	No Connection
10	V_{SS}	GND	20	DIM	Note 2

Note 1: IN n- and IN n+ (n=0, 1, 2, 3), CLK IN- and CLK IN+ should be wired by twist-pairs or side-by-side FPC patterns, respectively.
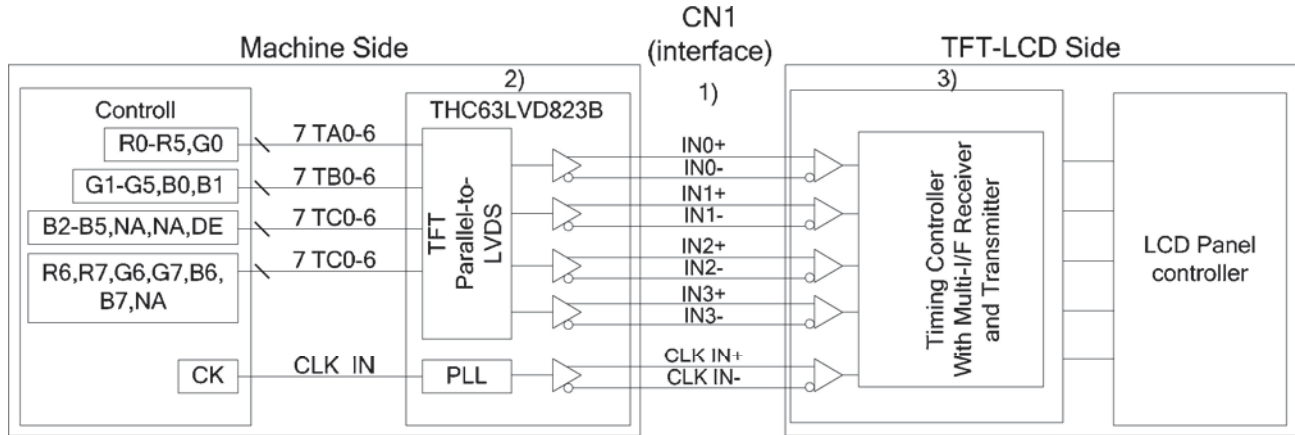
Note 2: Normal brightness: 0V or 0% PWM duty; Brightness control: 0V to 3.3V DC or 0% to 100% PWM duty.

The backlight connector (CN2) is SM02(8.0)B-BHS-1-TB(LF)(SN) made by JST, and pin assignment is as below:

Pin No.	Signal	Signal
1	V_{LED}	12VDC
2	GND	Ground

8.2 LVDS INTERFACE

CN1 (interface)

Machine Side | TFT-LCD Side

Controll
R0-R5,G0 — 7 TA0-6
G1-G5,B0,B1 — 7 TB0-6
B2-B5,NA,NA,DE — 7 TC0-6
R6,R7,G6,G7,B6,B7,NA — 7 TC0-6

THC63LVD823B
TFT Parallel-to-LVDS

CK — CLK IN — PLL

IN0+ IN0-
IN1+ IN1-
IN2+ IN2-
IN3+ IN3-
CLK IN+ CLK IN-

Timing Controller With Multi-I/F Receiver and Transmitter

LCD Panel controller

Note 1: LVDS cable impedance should be 100 ohms per signal line when each 2-lines (+, -) is used in differential mode.

Note 2: The recommended transmitter, THC63LVD823B, is made by Thine or equivalent, which is not contained in the module.

8.3 LVDS DATA FORMAT

1 cycle

CLK IN+
CLK IN-

IN0+ / IN0-: R1 R0 G0 R5 R4 R3 R2 R1 R0 G0

IN1+ / IN1-: G2 G1 B1 B0 G5 G4 G3 G2 G1 B1

IN2+ / IN2-: B3 B2 DE NA NA B5 B4 B3 B2 DE

IN3+ / IN3-: R7 R6 NA B7 B6 G7 G6 R7 R6 NA
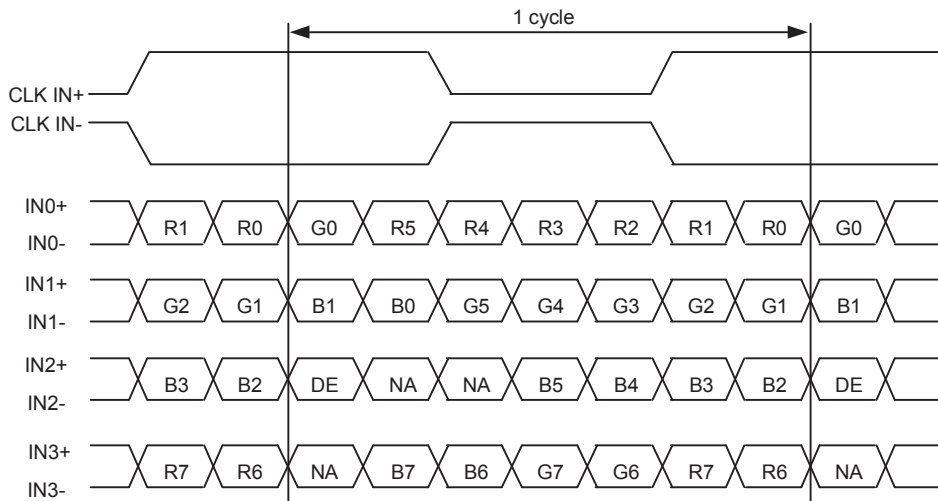
DE: Display Enable
NA: Not Available

8.4 TIMING CHART

Fig. 8.1 Horizontal Timing

Fig. 8.2 Vertical Timing
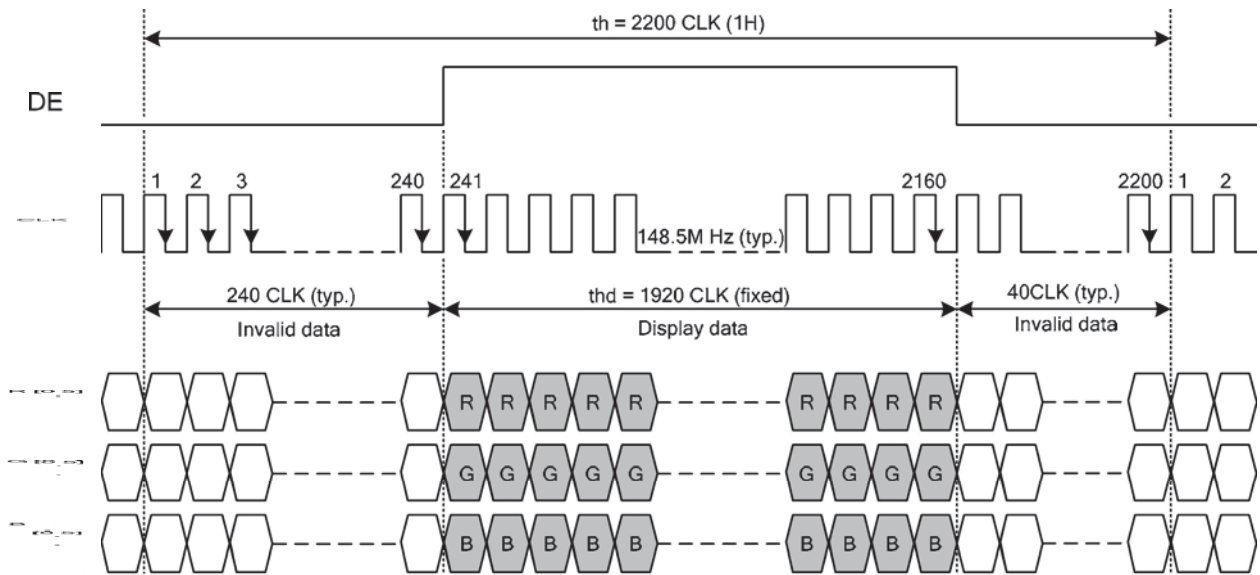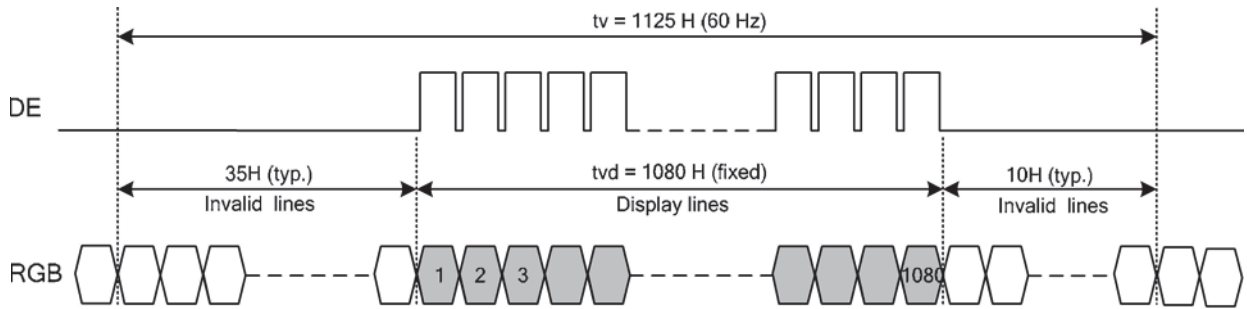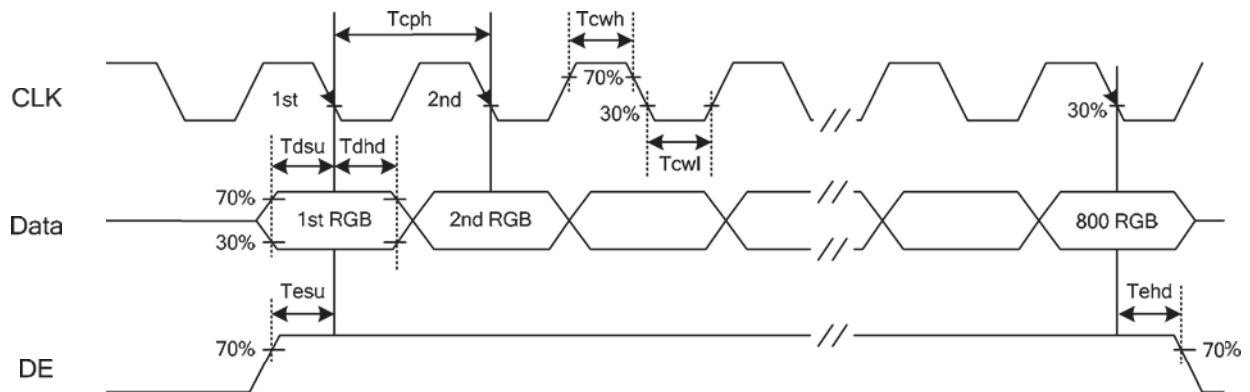
Fig. 8.3 Setup & Hold Time

8.5 TIMING TABLE

The column of timing sets including minimum, typical, and maximum as below are based on the best optical performance, frame frequency (Vsync) = 60Hz to define.

A. DE MODE

Item		Symbol	Min.	Typ.	Max.	Unit
Horizontal	CLK Frequency	fclk	-	148.5	-	MHz
	Display Data	thd	-	1920	-	CLK
	Cycle Time	th	-	2200	-	
Vertical	Display Line	tvd	-	1080	-	H
	Cycle Time	tv	-	1125	-	

B. CLOCK AND DATA INPUT TIMING

Item		Symbol	Min.	Typ.	Max.	Unit
CLK	Duty	Tcwh	45	50	55	%
	Cycle Time	Tcph	-	6.74	-	ns
Data	Setup Time	Tdsu	1	-	-	
	Hold Time	Tdhd	1	-	-	
DE	Setup Time	Tesu	1	-	-	
	Hold Time	Tehd	1	-	-	

8.6 LVDS RECEIVER TIMING

RinX= (RinX+)-(RinX-)   (X=0, 1, 2, 3)
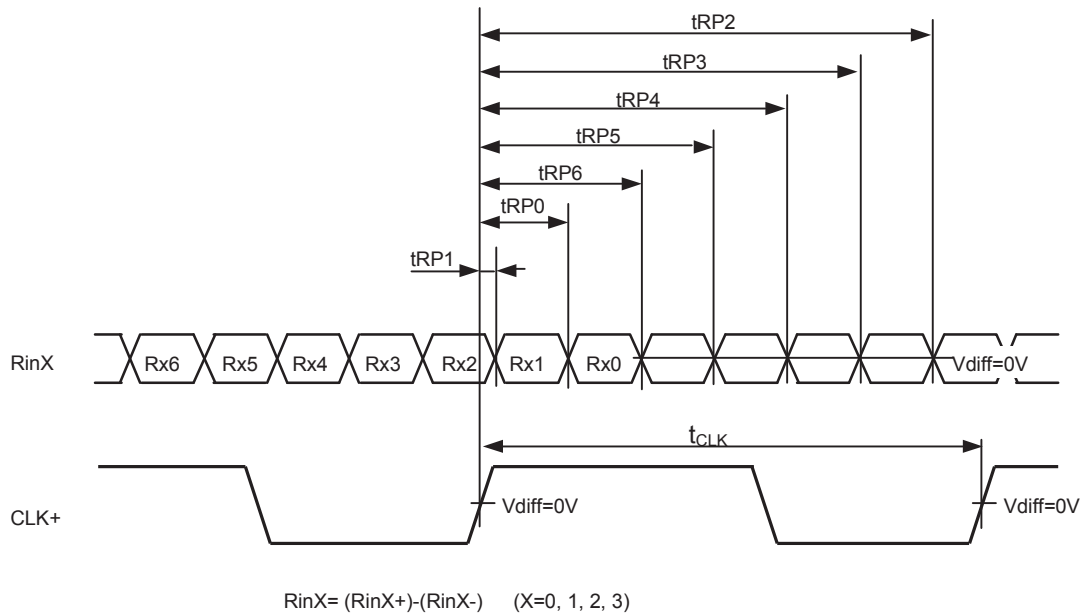
Item		Symbol	Min.	Typ.	Max.	Unit
CLK	Cycle frequency	$1/t_{CLK}$	-	148.5	-	MHz
RinX (X=0,1,2,3)	0 data position	$tRP0$	$1/7* t_{CLK} -0.49$	$1/7* t_{CLK}$	$1/7* t_{CLK} +0.49$	ns
	1st data position	$tRP1$	-0.49	0	+0.49	
	2nd data position	$tRP2$	$6/7* t_{CLK} -0.49$	$6/7* t_{CLK}$	$6/7* t_{CLK} +0.49$	
	3rd data position	$tRP3$	$5/7* t_{CLK} -0.49$	$5/7* t_{CLK}$	$5/7* t_{CLK} +0.49$	
	4th data position	$tRP4$	$4/7* t_{CLK} -0.49$	$4/7* t_{CLK}$	$4/7* t_{CLK} +0.49$	
	5th data position	$tRP5$	$3/7* t_{CLK} -0.49$	$3/7* t_{CLK}$	$3/7* t_{CLK} +0.49$	
	6th data position	$tRP6$	$2/7* t_{CLK} -0.49$	$2/7* t_{CLK}$	$2/7* t_{CLK} +0.49$	

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8.7 POWER SEQUENCE
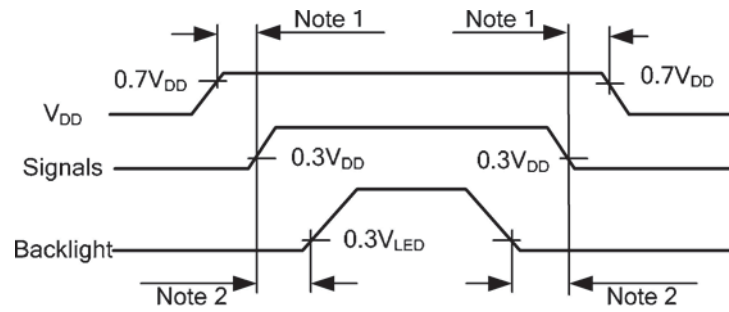
Fig. 8.4 Power Sequence Timing

Note 1: In order to avoid any damages, V_{DD} has to be applied before all other signals. The opposite is true for power off where V_{DD} has to be remained on until all other signals have been switch off. The recommended time period is 1 second.

Note 2: In order to avoid showing uncompleted patterns in transient state. It is recommended that switching the backlight on is delayed for 1 second after the signals have been applied. The opposite is true for power off where the backlight has to be switched off 1 second before the signals are removed.

8.8 DATA INPUT for DISPLAY COLOR

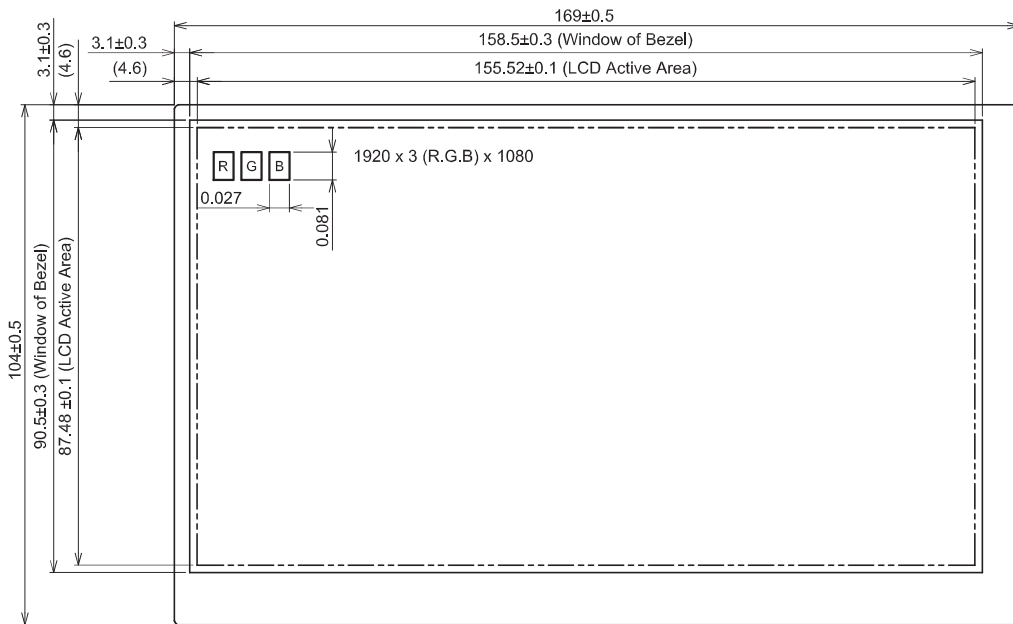| Input color		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		Red Data								Green Data								Blue Data							
		MSB							LSB	MSB							LSB	MSB							LSB
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Note 1: Definition of gray scale : Color(n) Number in parenthesis indicates gray scale level. Larger number corresponds to brighter level.
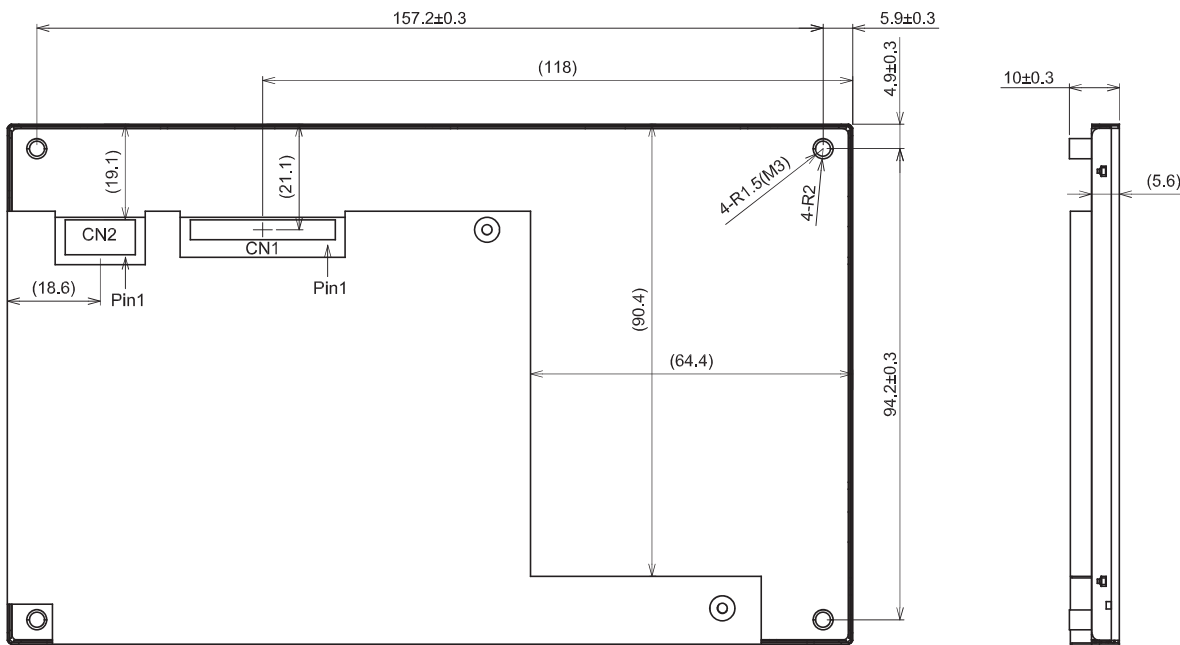
Note 2: Data Signal : 1 : High, 0 : Low

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9. OUTLINE DIMENSIONS
9.1 FRONT VIEW

169±0.5
158.5±0.3 (Window of Bezel)
155.52±0.1 (LCD Active Area)

3.1±0.3
(4.6)
3.1±0.3
(4.6)

1920 x 3 (R.G.B) x 1080

R G B

0.027
0.081

104±0.5
90.5±0.3 (Window of Bezel)
87.48 ±0.1 (LCD Active Area)

** Undefined tolerance is ±0.5mm

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9.2 REAR VIEW

** Undefined tolerance is ±0.5mm

Displays

US Micro Products is an industrial distributor specializing in engineered display solutions. We dedicate ourselves to providing the best in displays for the medical, industrial, gaming, automotive, aerospace, military and consumer markets.

OLEDs

TFT Display

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Touch Screen

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Trackballs

Aerospace Trackballs

Printers